Vacuum Plasma Spray Formed High Transition Temperature Shape Memory Alloys, Phase I

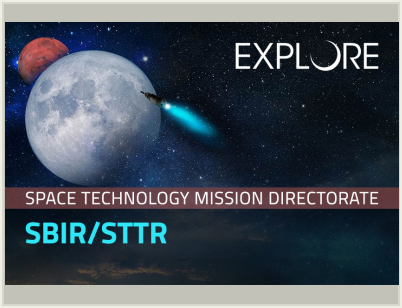
Completed Technology Project (2007 - 2007)

Project Introduction

Smart materials control of aero-surfaces based on shape memory alloys (SMA) is seeing increased use for improving of future subsonic fixed wing aircraft aero-surface controls. Such SMA actuators have the potential of lowering weight and increasing reliability through direct control. The binary NiTi system has been a preferred system but these alloys have austenite finish Af transition temperature in a reported range of 90 - 100C, which is too low for many applications. Therefore, there is strong interest in developing a class of ternary and/or quaternary alloys that incorporate Pd and/or other elemental additions. MRi is proposing to develop NiTiPd and NiTiPd+ X alloys that are capable of being directly formed via vacuum plasma spray (VPS) processing. These alloys have been shown to increase Af transformation temperature to over 350C, however, these alloys are also significantly less ductile and more prone to casting segregation. The proposed innovation has the potential to eliminate the typical cast/rolling/extrusion procedures typically used with NiTi alloys with a near-net vacuum plasma spray (VPS) forming process. If successful, the alloy and process development work to be conducted on the Phase I investigation would enable the VPS process to directly form shapes from NiTiPd-X alloys. The proposed Phase I research would be aimed at developing specific NiTiPd+X where X could be Hf, Zr and even B. The development work would focus on developing as deposited structures that would yield Af transition temperature from 130 - 300C. If successful, the development would enable the cost effective manufacture of higher temperature shape memory alloy actuators for use as remote actuation of aero-control surface and engine controls.

Anticipated Benefits

Other applications for VPS formed high temperature shape memory alloys include military and civilian uses such as torque and beam actuators for controling aero-surfaces, releases and door and hatch openings where higher power is needed and larger devices must be remotely controlled. Higher temperature acutuation temperature devices will also enble more reliable SMA aircraft engine controls. NASA application for VPS formed SMA devices includes a range of remotely controlled actuation devcies to open and close doors and release systems for manned or unmanned vehicles that could be used in NASA spacecraft and probes where remote releases are now being explosively activated. SMA release actuation would be much safer and recallable.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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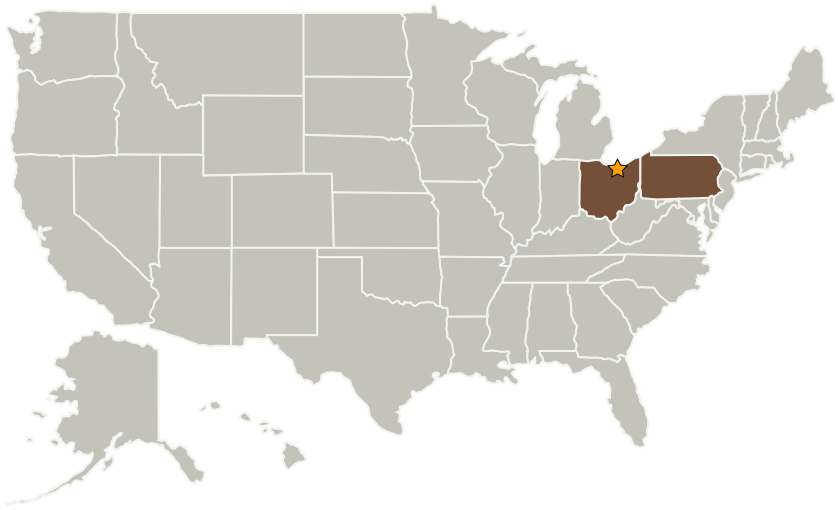
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Materials Resources International	Supporting Organization	Industry	Lansdale, Pennsylvania

Primary U.S. Work Locations	
Ohio	Pennsylvania

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Project Manager:
Ronald D Noebe

Principal Investigator:
Ronald Smith

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.8 Smart Materials